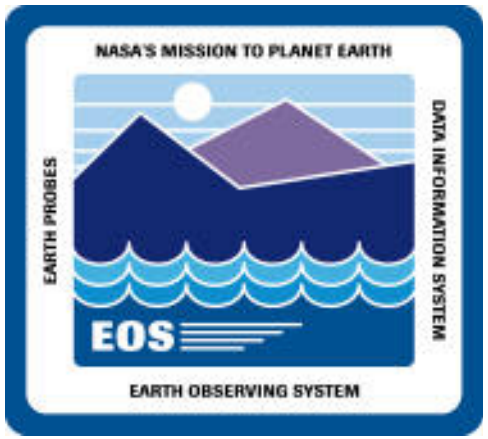

ECS DAAC LAN Architecture

Ezra Jalleta

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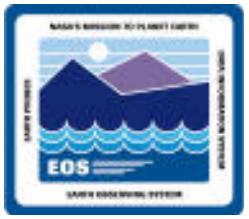
19 April 1996

Overview



- Driving Requirements
- Sizing Approach
- Release B DAAC LAN Architecture
- IP Addressing and Routing
- Network Security
- Failure/Recovery
- Capacity Breakpoints
- Evolvability
- COTS Selections

Presentation uses GSFC, EDC and JPL DAACs to illustrate design features; DAAC-unique designs will be presented during the "DAAC Day" sessions Monday (also in section 3.4.1 of DAAC-unique 305 volumes)

Driving Requirements

Separation of Push and Pull Flows

- **Do not want user pull to interfere with production flows**
- **Example: heavy user interest in data relating to a catastrophic event**

Very large data flows at some DAACs (GSFC, LaRC, and EDC)

- **Some flows far exceed FDDI capability**
- **These flows are between Data Server and Processing subsystems**

RMA

- **Networks need to contribute to RMA requirements as allocated to strings of functions**

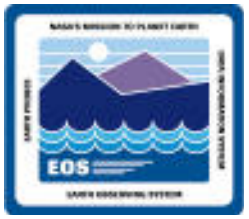
Security

- **Security is implemented using filtering on the network level (higher level applications will use DCE's security features)**

Scalability

- **Network should accommodate growth with minimum breakage**

Driving Requirements



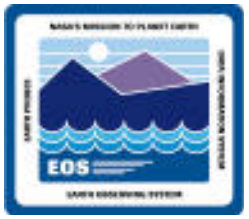
Evolvability

- **EOSD 5070; ECS shall enable expansion to GByte networks**

Management

- **Network should be manageable**

Sizing Approach



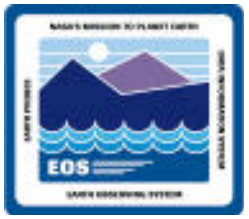
Sources for sizing

- **Static analysis of the February 1996 AHWGP baseline**
  - **production network, DAAC-to-DAAC flows (includes subsetting)**

- **February 1996 technical baseline - 1x electronic distribution**
  - **user network**

Examples: GSFC (large DAAC) and JPL (small DAAC)

Sizing Approach



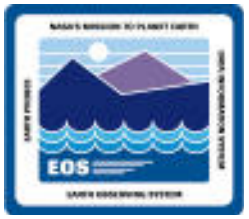
Major Release B Data Flows for GSFC DAAC

Major Data Flow Description *	Raw Volume (in Mbps)	Factors Applied	Weighted Volume (in Mbps)
Ingest to Working Storage Server	6.5	2,3,4,5,6	18.2
Working Storage Server to Processing	257.6	1,4,5,6,7,8	584.8
Working Storage Server to/from FSMS Server	408.8	1,4,5,6,7,8	928.0
Working Storage Server to Distribution Server	38.7	2,3,4,5	108.8
Working Storage Server to/from DAO Processing	13.6	2,3,4,5,6	38.2
ACM Server to/from other DAACs (includes TSDIS)	17.0	1,2,3,4,5,6	57.5
User Pull	34.4	2,3,4,5	96.7

Overhead Factors
1. SSI&T : 1.2
2. FDDI & TCP/IP Protocol Overhead: 1.25
3. FDDI Circuit Utilization: 1.25
4. Avg.-to-Peak Conversion: 1.5
5. Scheduling Contingency: 1.2
6. Operational Hours Factor: 1.0
7. HiPPI Protocol Overhead: 1.05
8. HiPPI Circuit Utilization: 1.0

- **Other flows (< 2 Mbps) include events, subscriptions, request tracking, sessions and SNMP**

Sizing Approach



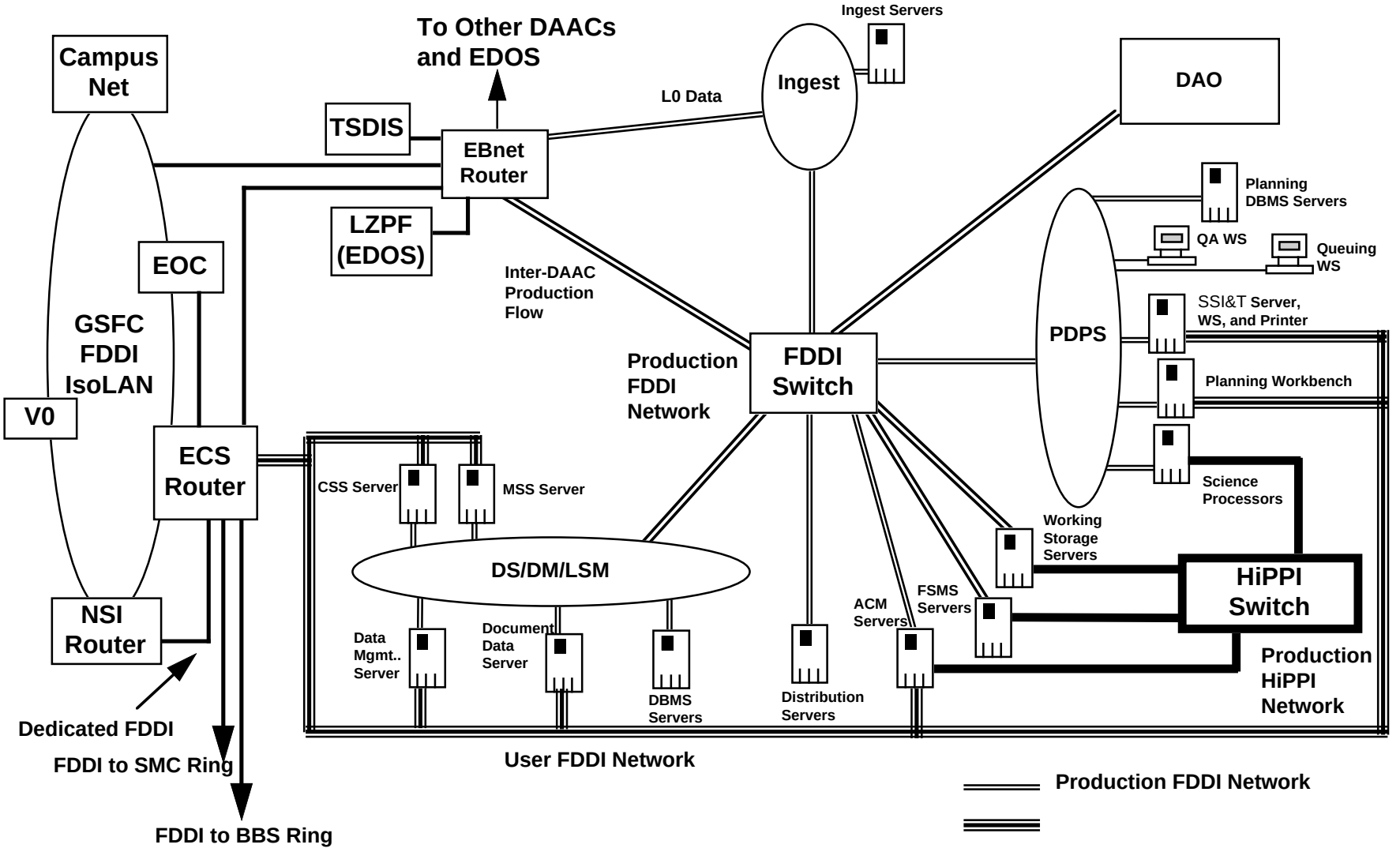
Major RB Data Flows for JPL DAAC

Major Data Flow Description *	Raw Volume (in Mbps)	Factors Applied	Weighted Volume (in Mbps)
FSMS Server to Processing	2.5	1,2,3,4,5,6	35.5
FSMS Server to Distribution Server	14.4	2,3,4,5	40.5
ACM Server to/from other DAACs	< 0.1	1,2,3,4,5,6	0.1
User Pull	1.3	2,3,4,5	3.7

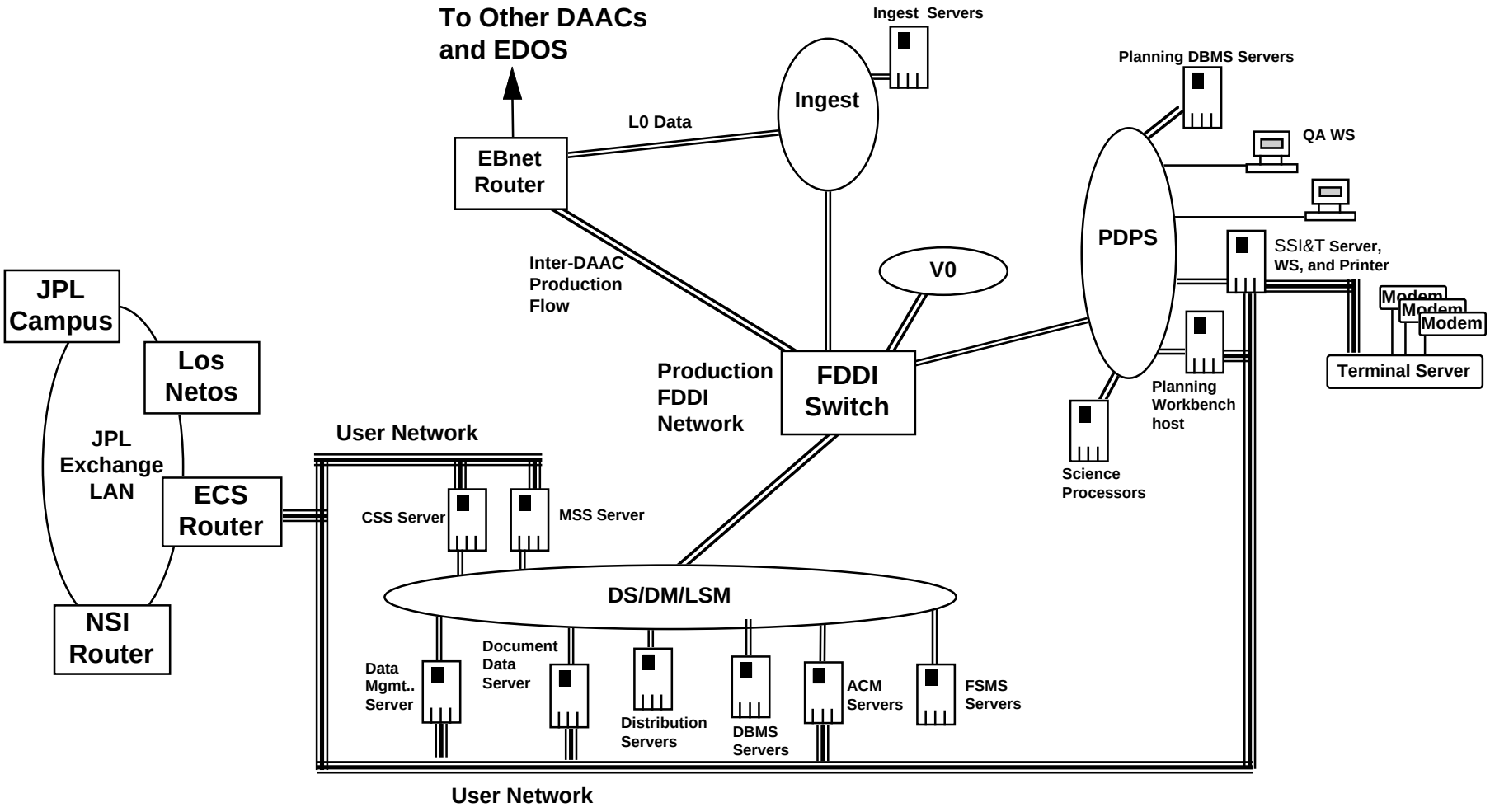
Overhead Factors
1. **SSI&T : 1.2**
2. **FDDI & TCP/IP Protocol Overhead: 1.25**
3. **FDDI Circuit Utilization: 1.25**
4. **Avg.-to-Peak Conversion: 1.5**
5. **Scheduling Contingency: 1.2**
6. **Operational Hours Factor: 4.2**
7. **HiPPI Protocol Overhead: 1.05**
8. **HiPPI Circuit Utilization: 1.0**

- **Other flows (< 1 Mbps) include events, subscriptions, request tracking, sessions and SNMP**

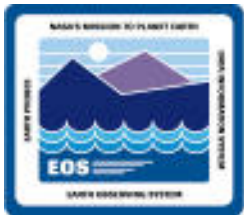
Release B GSFC DAAC LAN Architecture



Release B JPL DAAC LAN Architecture



Release B DAAC LAN Architecture: User Network



Separate network handles only user flows

- **Builds on Release A network topology**
- **(Generally) FDDI-based network solely for connectivity to users**
- **Prevents users from gaining direct access to production-only hosts**

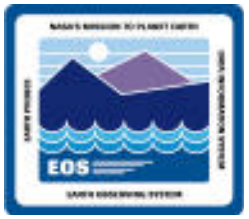
Only hosts requiring user access are connected

- **Data Manager and Data Server hosts (for browsing, ordering, etc.)**
- **LSM hosts (for receipt of management data such as from NSI, receipt of electronic mail, etc.; but no user interaction)**
- **Planning hosts (for remote access by Instrument Teams)**

Dedicated router interface to users

- **Router connects to NSI and local campus via exchange LAN**
- **Provides single controlled access point for all users**

Release B DAAC LAN Architecture: Production Network (FDDI)



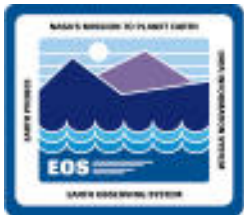
Switched FDDI-based network

- **Subsystems/hosts connected to FDDI rings according to data flow requirements**
  - **Some hosts have dedicated FDDI segments**
- **FDDI Switch provides high throughput**
  - **Allows flexibility to aggregate and segregate FDDI interfaces as required to support data flow requirements**

All production data received from EBnet interface

- **Multiple FDDI interfaces possible to handle high DAAC-DAAC volumes**
- **High RMA L0 data provided directly to dedicated Ingest ring**
- **Non-ECS production data also provided via EBnet**
  - **e.g., TSDIS at GSFC, LPS at EDC**
  - **Provides single interface for all production data**

Release B DAAC LAN Architecture:
High-Speed Production Network (HiPPI)



HiPPI (High-Performance Parallel Interface) Production Network

- 800 Mbps full-duplex switched (not shared) architecture
- Fully standardized and established

Connects Data Server and Processing hosts at some DAACs

- Creates a dedicated network to handle large data flows
- Network not accessed by other subsystems, other DAACs, or users

Implementation involves running IP over HiPPI

- BDS (Big Data Service) will be used to handle large flows over HiPPI
  - SGI's software enhancement to NFS to allow large data volume transfer at a high speed
  - Sits next to NFS in the protocol stack
  - Has been shown that a single HiPPI channel can deliver data at 60 MB/s using BDS
- Prototyping of both IP over HiPPI (both in-house and outside) and BDS over HiPPI (U of MN) show sufficient throughput rates

IP Addressing and Routing

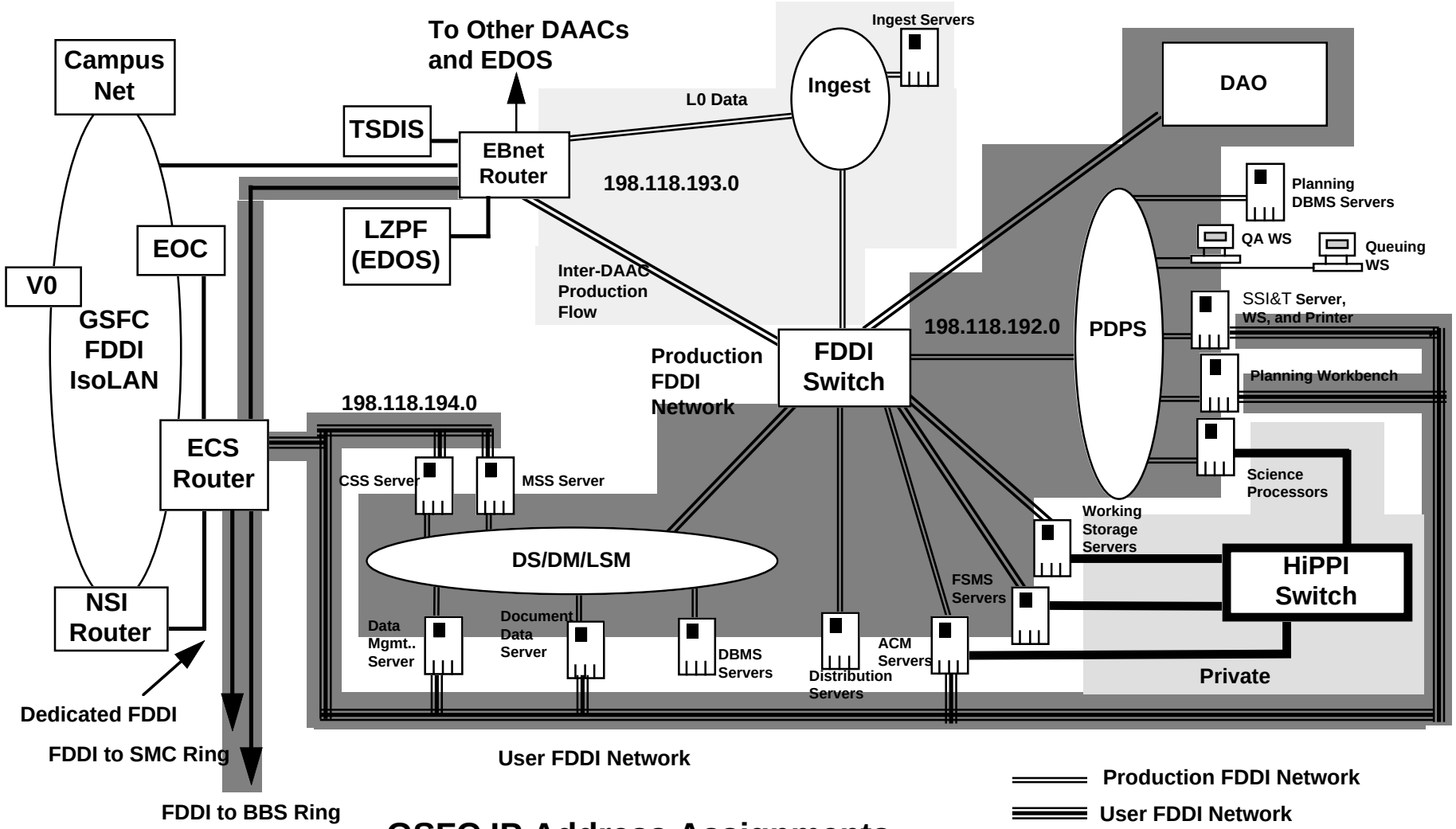
All DAACs use subnetted and whole Class C addresses

- **GSFC DAAC has been assigned three Class C addresses**
- **All other DAACs will have 2 Class C addresses**
- **The User Network is assigned a whole Class C and the Production Network has subnetted Class C addresses**
- **Release A Address assignments have already been made for GSFC and LaRC DAACs**

All DAAC Routing will be done using Routing Information Protocol (RIP)

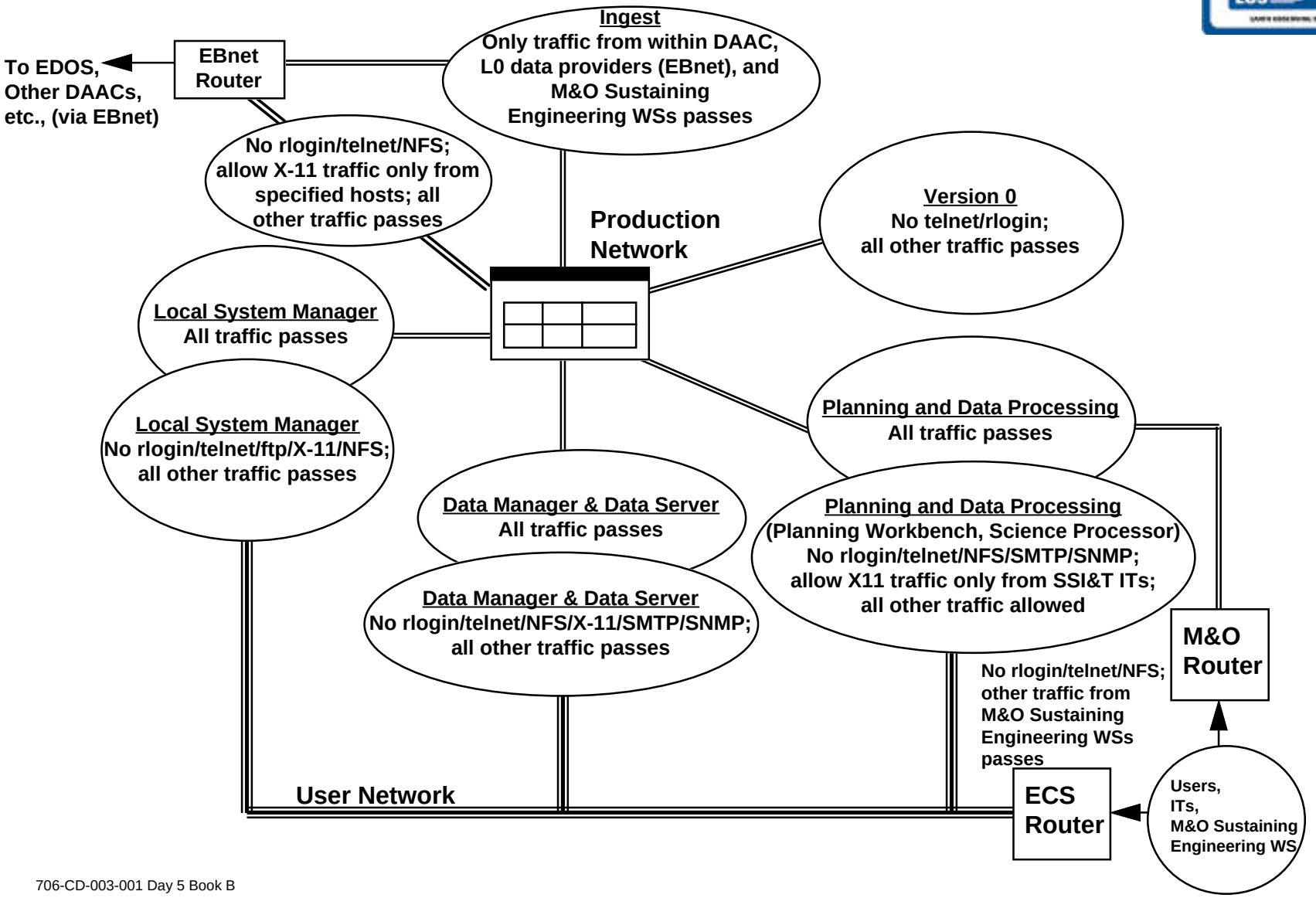
- **RIP will be used for routing within ECS DAAC LANs**
- **Routing between ECS routers and external networks (e.g., EBnet and NSI) will also be via RIP**
- **If NSI requires the use of BGP for route exchanges in the future, ECS routers will be able to support it**

IP Addressing and Routing



GSFC IP Address Assignments

Network Security



Failure and Recovery

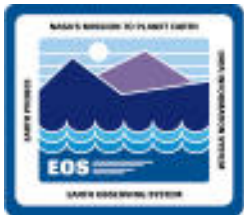
RMA

- **Central FDDI switch has redundant components (redundant packet engines, fans, power supply) and interface modules are hot swappable**
- **HiPPI switch does not have redundant components but has "semi-hotswapping" capability which uses a simple software command**

FDDI connectivity is such that there is minimal downtime (within RMA constraints)

- **DAS connections for servers on Production network**
  - **the servers are dual homed to separate concentrators**
- **SAS connections for workstations on Production network and servers (separate interface on the same production servers mentioned above) on the User Network**
  - **Workstations/Servers with SAS connections are backed by a peer workstation/server that is connected to a separate concentrator**

Failure and Recovery



Failover Scenario:

- **A HiPPI interface module fails**
- **An operations staff member notices this from the light indicators on the module**
- **The staff member promptly confirms the problem by looking at the interface status via an out-of-band Ethernet connection to the switch**
- **Staff immediately transfers the cables from the bad interface module to an “in line” spare interface module and issues a single software command to activate the spare module**
- **Staff also makes sure that the channel to the affected host is properly re-established**
- **All of this takes approximately 3 minutes**

Capacity Breakpoints

Additional capacity that can be sustained before breakage without adding any network component

Network Segment	GSFC DAAC	EDC DAAC	JPL DAAC
DS/DM/LSM Ring	60 %*	60 %*	14 %*
PDPS Ring	60 %*	60 %*	64 %*
Ingest Ring	70 %*	70 %*	75 %*
User Network	3 %*†	2 %*†	95 %*
HiPPI Fabric Connections	3	4	N/A
Dedicated Host Connections (of 100 Mbps each) to FDDI Switch	2	3	3
Dedicated Host Connections (of 100 Mbps each) to ECS Router	10	10	6
Available Concentrator Ports	User Network = 17 Production Network = 21	User Network = 15 Production Network = 19	User Network = 17 Production Network = 21

* The percentage indicates additional capacity left in a shared FDDI ring

† This amount rapidly increases when a subset of the user network hosts are attached to the ECS Router via dedicated FDDI connections.

IP Addresses -- There are enough spare IP addresses to accommodate at least 100% growth in IP addressable network nodes (based on Release B host counts)

Capacity Breakpoints (example: EDC)

Data Flow Description	*4X Weighted Volume (in Mbps)*	*10 X Weighted Volume (in Mbps)*
Working Storage Server to/from FSMS Server	861.4	1208.9
Working Storage Server to Distribution Server	279.2	493.9
User Pull	229.9	438.2

- In order to accommodate 4x and 10x increases:

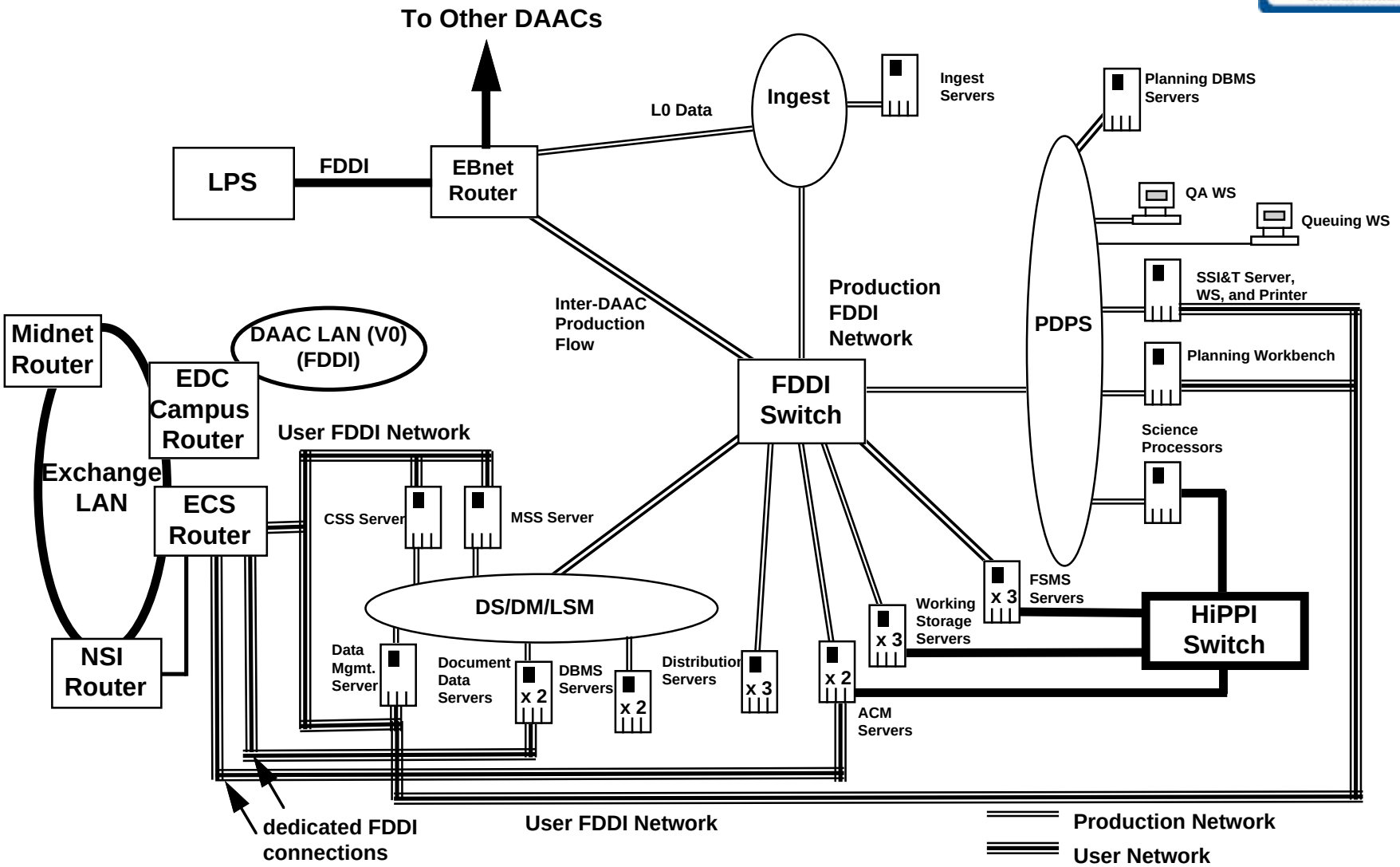
  -> several hosts on the user network would have to have dedicated FDDI connections to the ECS Router

  -> additional Data Server hosts would have to have dedicated FDDI connections to the Production Network FDDI switch (1.6 Gbps aggregate bandwidth)

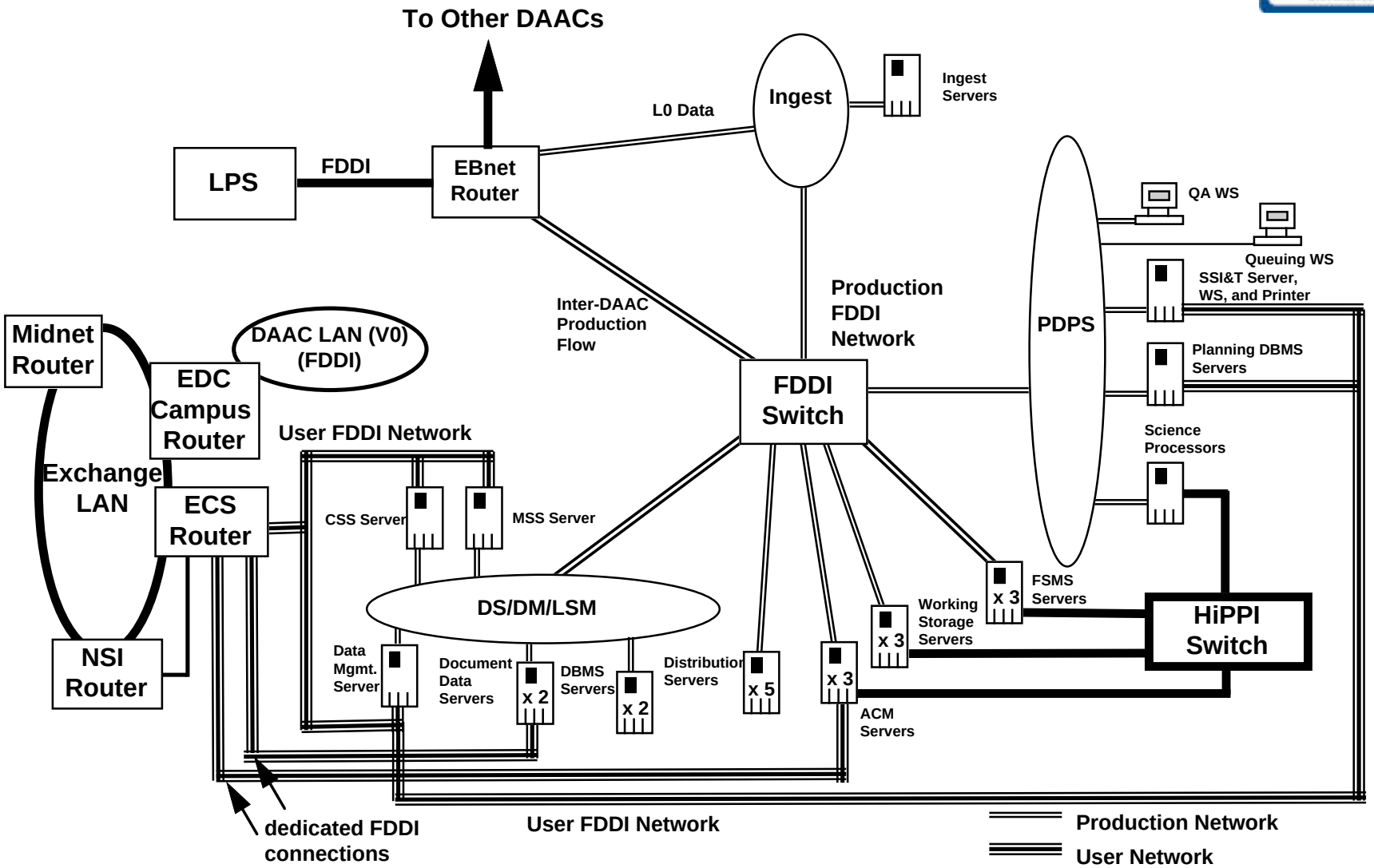
  -> additional Data Server hosts would have to have connections to the Production Network HiPPI switch (12.8 Gbps aggregate bandwidth)

  -> note that WAN connections of external networks (e.g., NSI) would have to be upgraded as well (e.g., several T3s or OC-3s or a single OC-12)

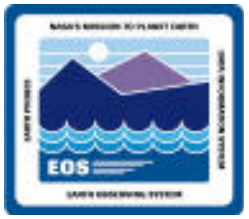
Capacity Breakpoints
(example: EDC, 4X)



Capacity Breakpoints
(example: EDC, 10 X)



Evolvability



FDDI Switch allows graceful growth path

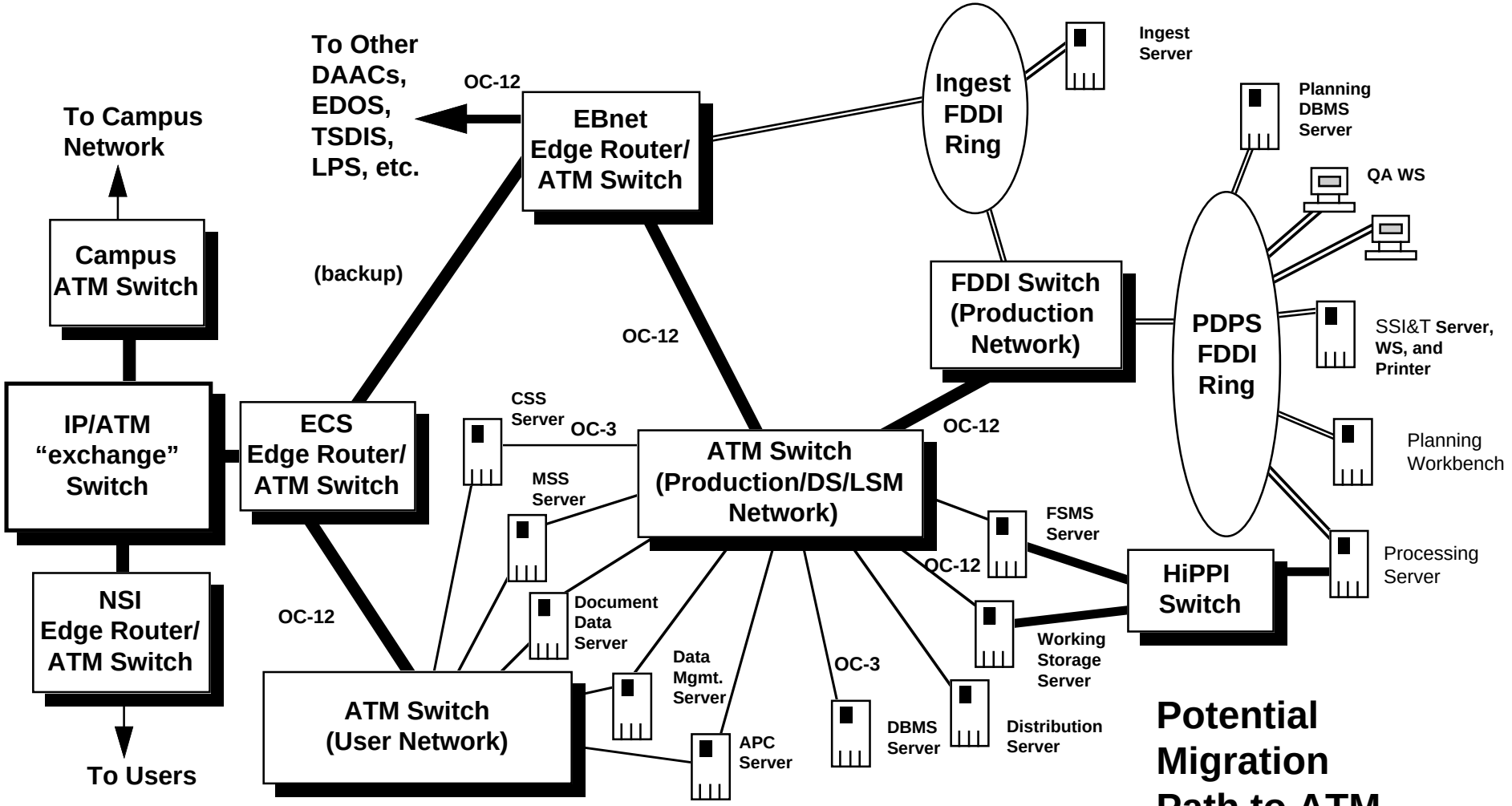
- **Currently supports up to 16 FDDI interfaces**
- **Flexibility to combine or separate FDDI rings as needed to support data rates**

Separation of User and Processing networks allows each to evolve independently as requirements and loads change

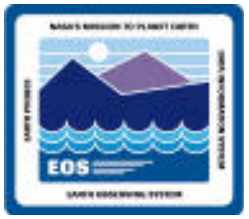
New technologies can be inserted into existing architecture

- **FDDI Switch has ATM interfaces to connect FDDI and ATM**
  - **Allows controlled migration to ATM compared to complete swap-out**
  - **Possible ATM interface to EBnet and NSI**

Evolvability



COTS Selections



- User Network router (no RFP required; vendors already on contract)
- HiPPI switch choice recommended to ESDIS
- FDDI switch selection
  - Alantec PowerHub 7000 and DEC GigaSwitch
- FDDI Concentrators (no RFP required; vendors already on contract)
- ECS Router (no RFP required; vendors already on contract)